KBMOS – Peer Review Comments, Task 2 – Workshop 1

Robert H. Prucha, Phd. PE
Integrated Hydro Systems, LLC

GOALS

1) Judge the quality and credibility of the science used to develop the OKISS and AFET models, particularly in their applicability to decision-making for operational management of structures in the Kissimmee Watershed.

- Find critical defects, if any, in the model and/or evaluation performance measures relative to the goal of understanding and predicting environmental, hydrologic and hydraulic responses to alternative management scenarios.
- Suggest remedies for such defects, and/or suggest the appropriate caveats to be understood by those who must interpret the model and/or evaluation performance measure results for decision support.
- Recommend avenues for future model and/or evaluation performance measure refinement.

2) The overall goal of this review is to provide unbiased, expert assessment of whether the sciences that underlie the KBMOS model framework will to support the development of improved operational rules for water control structures within the Kissimmee watershed.

GOALS

I. Essential recommendations

Comments or questions that involve major model strengths, and/or crucial model deficiencies that must be addressed prior to application of the KBMOS to long-term project planning.

A) Principal strengths of model and its application

B) Clarifications that are required

C) Corrections or refinements that are required, indicating "why and how"

II. Non-essential recommendations

Comments or questions that involve useful model features, or improvements to model utility for long-term project planning.

A) Useful features of the model and its application

B) Clarifications that would improve model understanding

C) Corrections or refinements that would increase model utility, indicating "why and how"

III. Editorial comments (optional)

The Goals and Objectives of Review do not include editing the readability or style of document. However, the District welcomes such editorial comments/suggestions.

A) Strengths of documentation

B) Improvements to organization of documentation

C) Improvements to readability of text and graphics

TASK 2 - Objectives

- Assess the process used to select modeling tools
- Assess the suitability of the selected *codes,* models, and evaluation performance measures to evaluate *the relative performance of* existing and proposed Kissimmee Basin structure operating criteria in the AES.
- Assess the Alternative Evaluation System

Document 1. *Task 1.5 Model Evaluation Report: Kissimmee Basin Hydrologic Assessment, Modeling and Operations Planning, May 2005*

- **Objective 1 – Overall the code selection process seems appropriate – no critical defects.**
  - **Documentation:** **generally good, some improvement**
    - **Justification:** **improve**
    - **Organization:** **good**
    - **Completeness:** **improve**
    - **Depth/Breadth:** **good**
  - **Selected codes:** **selected codes seem to be best choice for meeting objectives.**
  - **Selection process:** **seems pretty thorough.**
    -good for AFET,
    -screening tool – wasn't really selected from a pool of codes like MSHE/M11. But it does seem appropriate.

Document 1 - Justification

- Summarizing code capabilities in a large table would have been very useful for the reader to quickly see where some codes fall short.

		Surface flow			Subsurface flow							
Hydrologic model code	Primary purpose	Spatial representation	Overland flow	Channel/reservoir routing	Infiltration/unsaturated flow	Groundwater flow	Evapotranspiration Plant growth	Snow melt	Sediment transport	Water quality Chemical transport	Additional features/ considerations?
MIKE SHE Danish Hydraulic Institute, British Institute of Hydrology, and SOGREAH (France)	Simulation of interrelationships among hydrologic processes in relation to watershed modifications	Fully Distributed in space and time. (Limited to square grid)	2-dimensional kinematic wave routing. Uses DEM data directly	complete dynamic flow routing equations with various control structures (gates, culverts). 'Floodplains' used to simulate ponds and their interaction with unsaturated zone & groundwater. Muskingham routing option	1-Dimensional Richard's Equation Solution with time varying water table (Simplified gravity-only method or, spatial lumping of 1-D columns allowed for increased efficiency)	Finite difference, 3-dimensional, accepts MODFLOW files but with some differences. Simplified linear reservoir model an option	Potential ET from Kristensen and Jensen Method where actual ET based on calculated soil moisture. Penman-Monteith to be added in Spring 2001	Degree-Day Snowmelt Model (Temperature-based model)	Physically-based sediment transport module for both cohesive and non-cohesive sediments	Separate Modules Available for both water quality and chemical transport	Yes, several other options are available. Additional graphical features (i.e., Mike/SHE GIS) are available to improve efficiency. Includes Macropore Flow
TOPOG-Dynamic (CSIRO, Australia)	Variable Source Area Representation of Streamflow Generation	Contour Based Elements. (Flow trajectories determined for each sub-watershed)	1-D kinematic wave flow	1-D kinematic channel network routing	1-D Richard's Equation Solution (3 numerical methods, mixed form very efficient) Simplifications Available	Hayer, lumped reservoir (Soil Bucket Model)	Potential ET from Penman-Monteith, actual ET based on moisture accounting	Snow component not yet coupled with model	Based on boundary sheer stress of overland flow; no channel sediment transport component	Chemical transport included	Includes Macropore flow. Only runs on Unix OS. Authors indicate intended use if for 'research'
Precipitation-Runoff Modeling System (PRMS) USGS New Version is MMS	Streamflow response to climate and land use conditions. Primarily intended for Large-scale hydrologic basins	Hydrologic Response Unit (HRU)	not included in continuous simulation	no flood routing for continuous simulation (see note to right)	2-layered reservoir accounting model based on Green-Ampt	lumped linear, or non-linear reservoir accounting model	Potential ET from Empirical Methods, Actual ET based on Soil Moisture	Temperature-based model	No sediment transport for continuous simulation	No Chemical Transport No Channel Routing in 24 Hr Time Period. Simulates contaminant runoff with instream water quality and sediment	Integrates with the USGS Modular Modeling System (MMS) graphical user interface based on X-Windows Environment

Document 1 - Completeness

- It would have been more transparent to all readers to summarize evaluator responses to each criteria (i.e., Table 5.5-1), rather than just showing a compilation of scores (Table 5.5-3). This could have been included as an Appendix.
- Although identified as a potential problem in the selection process, it is unclear how obvious bias for the final selected codes (MIKE SHE/MIKE 11 and MOD-HMS) was ultimately resolved in a transparent and unbiased fashion.
- Code verification – did code developers provide demonstration of rigorous testing against known solutions?

Document 2. *Screening Tool Proof of Concept Test Plan, Kissimmee Basin Hydrologic Assessment, Modeling and Operations Planning, September 2005*

Objective 1 – Assess the process used to select modeling tools

FINDINGS:

- The process used to demonstrate that OASIS can be used to meet the KBMOS objectives seems appropriate.
- Documentation: The only recommendation was to clarify how the OASIS results will be compared against the AFET tool to further justify using this code.

Document 3. *OASIS KCOL Model Report, Kissimmee Basin Hydrologic Assessment, Modeling and Operations Planning Study, February 2006*

Objective 1 – Assess the process used to select modeling tools

FINDINGS:

- This document seems to further justify using OASIS for KBMOS objectives.
- Documentation – some suggestions
  - Concerns were that valid alternatives would not be promoted due to simplification and inability to consider all performance measures.
  - Comments were mainly about how the AFETS tool compares to this screening-level tool.
  - Responses indicated this would be considered and is important.
  - Suggestion → provide clarification

Document 3 - Concerns

- It's not clear how the subset of performance measures will be selected or used in the screening, and whether using this subset would eliminate any possibly higher scoring alternative operation plans? Where is this described?

  Response: The OKISS TDD contains a similar table identifying the subset of Performance Measures that will be evaluated with the Screening Tool.
- It seems like more error will be generated using the simpler, mass-balance codes OASIS or UKISS for each alternative evaluated. How does a stakeholder get a sense that the error is not so large for some conditions that some plans aren't unnecessarily omitted.

  Response: Knowledge gained during this phase of the effort will be incorporated into the reporting of results.

  Comment: If error is large, what steps will be taken to address this issue?

Document 3 - Concerns

- Could the calibrated MIKE SHE/MIKE 11 model be used to evaluate the performance of both codes UKISS and OASIS for the same set of conditions (i.e., future conditions, or LKB) and times?

  Response:

  - An acceptable MIKE SHE/MIKE 11 model for the KB was not available at the time the Screening Tool was selected.
  - The Study team is aware of the importance of verifying the compatibility amongst the study modeling tools. The current Work Plan includes a validation effort to compare results obtained with AFET and OKISS. This comparison will not only be limited to stages and flows, Performance Measures will be evaluated and compared using output from the two models.

Document 4. *Kissimmee Basin Hydrologic Assessment: Modeling and Operations Planning Study: Screening Tool Proof of Concept Demonstration and Design WorkshopSummary Notes:*

Objective 1 – Assess the process used to select modeling tools

FINDINGS:

- Provides support in demonstrating applicability of OKCOL as screening tool for KBMOS.

Document 5. *Kissimmee Basin Modeling and Operations Study: Base Condition Summary Report, January 2007*

Objective 2.B. Assess the suitability of the selected *codes,* models, and evaluation performance measures to evaluate *the relative performance of* existing and proposed Kissimmee Basin structure operating criteria in the AES.

Objective 2.C. Assess the Alternative Evaluation System

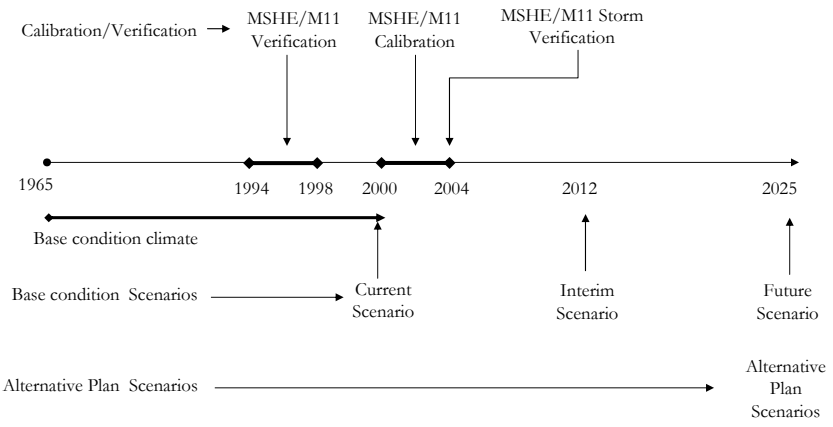
FINDINGS:

- I found no critical issues with this report, and the base condition definition seems suitable for evaluating the performance of basin structure operating criteria in the AES.
- Assessing suitability depends on:
  - *how well models reproduce actual flow conditions (calibration) and*
  - *how well they compare against each other for each base condition and set of operating criteria.*
- Concerns→

Document 5 – Concerns

- **Boundary condition assumptions:**
  - Use of base condition lateral inflows for screening & formulation models → this is different than evaluation model
  - Constant GW boundary conditions in MSHE/M11 model.
  - Recommendation – Demonstrate these won't affect scoring.
- For the screening and formulation tools – Do "lateral inflows" also include "lateral outflows" (i.e., ET and discharge from ponds, lakes, rivers into the GW system? Is it only surface runoff? If outflows are not considered significant, it should be demonstrated and clarified in the report.
- Calibration effects on AES Prediction

Document 5 – Concerns



Document 5 – Concerns

MSHE-M11 Calibration

Source of "Prediction Uncertainty"
(or Calibration error)

- **Parameter Uncertainty**

Suggestions:

1) Acknowledge and Discuss Calibration Error up front
2) Determine effects of parameter uncertainty on predictions to the extent possible
3) Incorporate and report on this in the AES alternative plan selection process.

Document 6. *Evaluation Performance Measures and Indicators, January 2007*

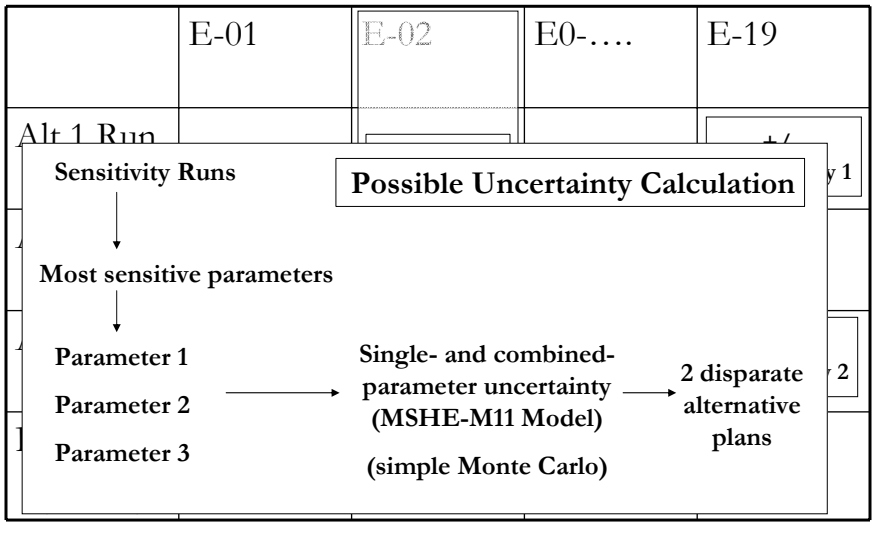
Objective 2.B. Assess the suitability of the selected *codes,* models, and evaluation performance measures to evaluate *the relative performance of* existing and proposed Kissimmee Basin structure operating criteria in the AES.

Objective 2.C. Assess the Alternative Evaluation System

FINDINGS:

- In general, this report presents a good deal of information, much of which seems to be in transition – so it is difficult to fully assess. Despite this, the report seems well organized, complete, in-depth and meets its objectives:
  - define desirable hydrologic characteristics within the waterbodies controlled by C&SF project structures and
  - to address the KBMOS operating objectives.
- The performance measures appear to be suitable for use in the AES.
- One critical issue relates to how calibrated model error, and uncertainty in base condition simulations will be addressed in the AES. →

Document 6 – Concerns



Document 8. *Kissimmee Basin Modeling and Operations Study: Alternative Evaluation System Technical Design Document: January 2007*

Objective 2.B. Assess the suitability of the selected *codes,* models, and evaluation performance measures to evaluate *the relative performance of* existing and proposed Kissimmee Basin structure operating criteria in the AES.

Objective 2.C. Assess the Alternative Evaluation System

Assessment Questions:

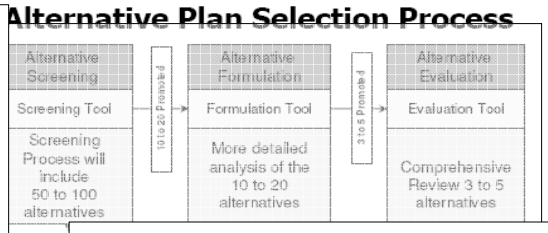
- Does the alternative evaluation system meet its objectives of being unbiased, transparent, repeatable, documentable, and implementable?
- Will the proposed modeling tools, evaluation performance measures, and alternative evaluation system allow for the selection of a preferred alternative? Will end users be able to differentiate between alternative plans?

Document 8 – Concerns

1) Will valid alternatives be

3) A poorly calibrated model, and model uncertainty may distinguish between alternatives, but does not guarantee it is accurate and realistic. → Suggest including/discussing prediction uncertainty in AES

weighting might reduce weighting bias.



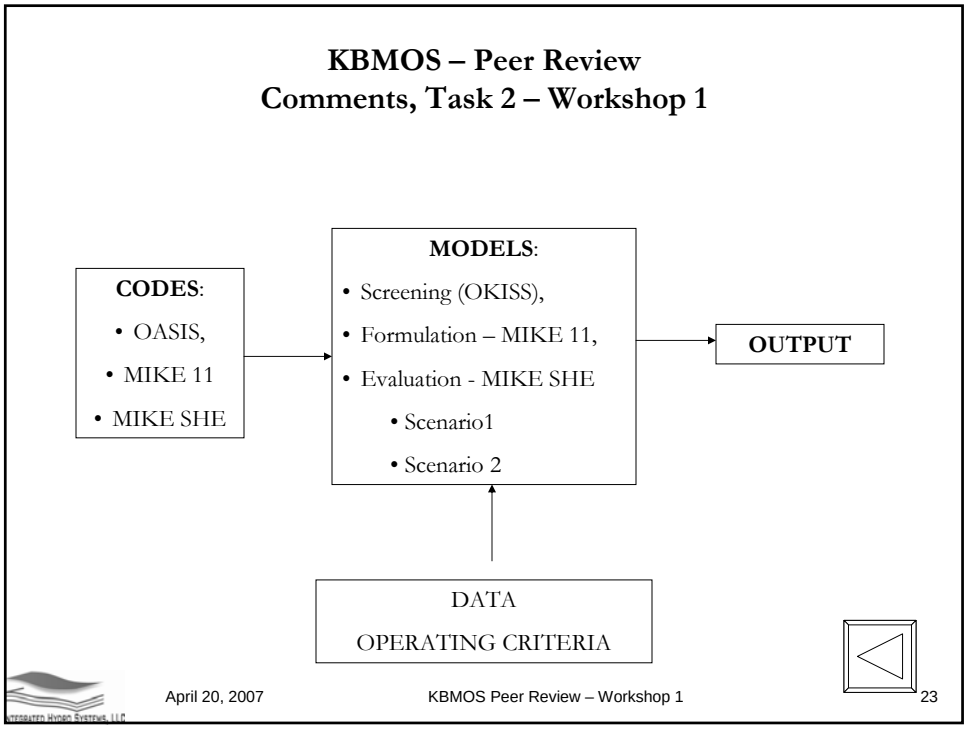
Alternative Evaluation System

- Peformance measures
- Metrics
- Process (PM and Metrics)
- Reporting

Document 6 – Concerns

GENERAL COMMENTS
KBMOS – Peer Review
Comments, Task 2 – Workshop 1

- Review would be easier, if details of observed and conceptual integrated flow system diagram, components & mass-balance were discussed up front –
  - to better assess suitability of tools to meet KBMOS objectives.
  - I still have a problem seeing level of SW/GW interaction and bearing on overall water balance for the system.
- A time-line of key hydrologic & hydraulic stresses, or land-use & operation would be very helpful – in some document (1965 to 2000).
- Review process might be more stream-lined if all documents were reviewed 1st – i.e., 'initial' review.
  - This would limit initial questions and improve the overall understanding of entire process/products/goals etc.
- These documents suggest selection of alternative plan, but what about actual implementation?


KBMOS – Peer Review
Comments, Task 2 – Workshop 1
CODES:
• OASIS,
• MIKE 11
• MIKE SHE
MODELS:
• Screening (OKISS),
• Formulation – MIKE 11,
• Evaluation - MIKE SHE
• Scenario1
• Scenario 2
OUTPUT
DATA
OPERATING CRITERIA
April 20, 2007
KBMOS Peer Review – Workshop 1
23